REMARKS

Claims 24-30 are pending and currently under examination in this application. The specification has been amended in conformity with the parent applications. The marked up version of the amendments to the specification are attached hereto and are captioned **"Version with Markings to Show Changes Made."** The amendments to the specification and the outstanding rejections will be addressed below.

I. Amendments to the Specification.

The specification has been amended to correct typographical errors in conformity with the parent applications (issued as U.S Patent Nos. 6,004,603 and 6,303,176). Applicants respectfully submit that the amendments to the specification submitted herein are supported by the application as filed for the reasons of record in the parent applications, and respectfully request entry thereof.

II. Written Description.

The claims stand rejected under 35 USC § 112 and the specification is objected to under 37 CFR § 1.71 on the basis that the specification fails to provide an adequate written description of the invention. In particular, the Office Action states that "the specification refers to lines of Figure 1 that appear to not exist therein or are named differently." (Office Action, page 2, para. 1).

Applicants have amended the specification herein to correct typographical errors and to conform the description to include the proper references to the lines in Figure 1 (*e.g.*, "yolk 9D *Salmonella* line" has been changed to "Yolk"). These amendments were previously entered in the parent applications (issued as U.S Patent Nos. 6,004,603 and 6,303,176). Applicants apologize for this oversight and for not previously presenting these amendments.

In view of the amendments to the specification, Applicants respectfully submit that the application satisfies the requirements of 35 USC § 112 and 37 CFR § 1.71 as the lines of Figure 1 are now referred to in the same manner in the figure and the specification, and respectfully request that the rejection on this basis be withdrawn.

III. The Section 102 Rejections.

Claims 24-30 stand rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Patent No. 5,431,939 and/or U.S. Patent No. 5,589,211 (both issued to Cox *et al.*). These rejections will be addressed individually below.

A. The '939 Patent.

Claims 24-30 stand rejected under 35 U.S.C. § 102(e) based on United States Patent No. 5,431,939 to Cox *et al.* (hereinafter "the '939 patent).

Applicants note that Applicants have addressed and overcome rejections based on the '939 patent in the parent applications. Applicants incorporate by reference in their entirety all applicable arguments and supporting evidence, such as, for example, the previously submitted Rule 132 Declaration of Hershell R. Ball, PhD (originally submitted on January 8, 1997; copy provided at Tab A without attachments) and the Supplemental Ball Declaration under 37 C.F.R. 1.132, as if presented in the current case (originally submitted on June 23, 1998; copy provided at Tab B). Applicants submit that for those reasons alone, the present rejection should be withdrawn.

Applicants respectfully submit that Cox *et al.* does not disclose an egg having the claimed reductions in SE which can be assured to be *Salmonella* negative without using thermal treatments at or above the Expected *Salmonella* line of Figure 1. The present invention provides the discovery that thermal treatment can be employed with intact shell eggs to eliminate *Salmonella* contamination therein utilizing a range of thermal treatments less severe than those which the '939 patent considered sufficient to eliminate *Salmonella*. The present application discloses time and temperature ranges

for employing thermal treatments so as to achieve the claimed reductions in SE (*e.g.*, at least about a 5D reduction in the albumen and the yolk) in intact shell eggs without adversely affecting egg quality and functionality. These optimized time and temperature conditions have not previously been appreciated by the art. In fact, it was previously believed that thermal pasteurization of intact shell eggs was not feasible because the treatment conditions required to eliminate *Salmonella* are so severe as to adversely affect egg functional properties.

Furthermore, the three publications submitted as items 51, 59 and 61 of Applicants' previous PTO-1449 form submitted August 6, 2001, provide additional evidence that the success of the present invention in effectively pasteurizing intact shell eggs would have been unexpected to those of ordinary skill in the art at the time of invention. All three references were published after the filing date of the present invention, and all teach away from the present invention.

Van Lith *et al.*, (1995) *Archiv. fur Geflugelkunde* **59**, 157-160, evaluated the effects of heating chicken shell eggs in a water bath heated at 57 °C for 25-30 minutes on *Salmonella* kill. These investigators found that only a 3D reduction in *Salmonella* could be achieved by heating at 57 °C for 30 minutes, and further found that longer heating was not feasible as it would harm the quality of the egg. Specifically, Van Lith *et al.* state:

> From the calculated internal temperatures, it could already be expected, that this heat treatment in water [at 57° C] **never** could be effective to destroy *Salmonella* bacteria if present. The results in Table 3 confirm this finding. (page 159, Col. 1, paragraph 5; emphasis added).
>
> Pasteurization of table eggs at 57 °C using the method originally patented for the treatment of duck eggs to eliminate *Salmonellae* did not result in *Salmonella* free eggs. As the albumen coagulates strongly already at the temperature and time combination above 57°C and 20 minutes, no beneficial effect from higher temperatures of longer times can be expected. (page 159, Col. 1, paragraphs 7 and 8; emphasis added)

> The pasteurization treatment proved to be ineffective and this could have been predicted by measuring the internal temperatures in the egg during the heat treatment. The results were confirmed by the microbiological tests, which showed that *Salmonellae* survived the treatment of eggs at 57 °C for 30 minutes. (page 159, Col. 2, paragraphs 4 and 5; emphasis added).

Hou *et al.*, (1996) *Food Microbiology* **13**:93-101, also found that "[e]ggs pasteurized in a 57 °C circulating water-bath for 25 min gave a reduction in *S. enteritidis* ATCC 13076 of about 3 log cycles." (Abstract; emphasis added). This reference further explains:

> The use of a 57 °C water-bath gave a maximum temperature increase without protein denaturation for up to 30 min. Prior exploratory work indicated that extended incubation times for more than 30 min often resulted in denatured egg white proteins as a result of the egg white reaching a critical temperature of 57 °C (data not shown). Therefore, the maximum allowable destruction of *S. enteritidis* ATCC 13076 in shell eggs by water-bath heating without egg white denaturation was approximately 3 logs (Fig 1.) (page 97, Col. 2, line 12 to page 98, Col. 1, line 10; emphasis added).

Likewise, Stadelman *et al.*, (1996) *Poultry Sci.* **75**:1122, report that their results "confirmed the observation by Van Lith *et al.* (1995) of the partial reduction (3-log cycles, Figure 4) of the inoculated cells during water bath heating and of protein denaturation of egg proteins during extended incubation at [57 °C]." (page 1124, Col. 1, paragraph 2).

In sum, the Van Lith *et al.*, Stadelman *et al.*, and Hou *et al.* references all teach away from the thermally treated shell egg of the present invention. The Applicants have provided a method of heating shell eggs so as to achieve at least a 5D reduction in *Salmonella* without impairing egg functionality, which can insure *Salmonella* negative results and which is less severe than the thermal treatments which are disclosed by Cox *et al.* in the '939 patent. Clearly, as indicated by the three references discussed above, such a result has eluded others skilled in the art.

Moreover, the '939 patent does not provide pasteurization of shell eggs using the claimed thermal treatments (*see, e.g.*, the Supplemental Rule 132

Declaration of Hershell R. Ball, Jr., Ph.D., submitted on June 23, 1998; copy enclosed at **Tab B**). The '939 patent, at most, represents an accidental anticipation, one that would not be appreciated by those of ordinary skill in the art. The '939 patent does not examine the effects of thermal treatment on pasteurization at all. The Examiner appears to be stating that such pasteurization effects would be inherent in Example 1 described by the '939 patent, *i.e.*, "Cox et al discloses the egg product claimed wherein said egg has been treated to time and temperature values within the areas of Figure 1 that indicate the particular *Salmonella* reduction values of the instant invention." (11/23/01 Official Action, page 2, lines 3-5 from bottom of page). Arguendo, even if the Examiner is correct and the examples in the '939 patent did achieve pasteurization, such effects would not have been appreciated based on the disclosure of the '939 patent. The only disclosure from which such teachings may be derived is the present application. In the absence of any teachings regarding pasteurization, the '939 patent would not teach one of ordinary skill in the art that thermal treatment can be employed to pasteurize shell eggs without impairing egg functionality. "[A]ccidental results, not intended and not appreciated, do not constitute anticipation." *Eibel Process Co. v. Minnesota & Ontario Paper Co.*, 261 U.S. 45, 66 (1923).

Finally, it seems likely that Cox *et al.* did not believe that thermal treatments would be effective to pasteurize shell egg without coagulation – none of the claims of the '939 patent are directed to such methods. Moreover, it can logically be presumed that Cox *et al.* omitted Figure 10 when filing the continuation-in-part application that issued as U.S. Patent No. 5,589,211 because Figure 10 suggests that pasteurization of shell eggs can only be achieved at unacceptably high thermal treatments. Thus, Applicants submit that Cox *et al.* themselves understood that the '939 patent was not enabling to teach one of skill in the art how to provide thermally treated shell eggs which may be insured to be *Salmonella* negative as the figures relating to the early work described in the '939 patent were removed from subsequent Cox *et al.* patents (patents which are not prior art to the present application as they were not prior art to the parent applications).

In sum, Applicants respectfully submit that the subject matter of pending Claims 24-30 is neither disclosed nor suggested by the '939 patent to Cox *et al.* For the reasons set forth above, Applicants respectfully submit that the pending claims are patentable over the '939 patent and request that the outstanding rejection under 35 U.S.C. § 102 (e) be withdrawn.

B. The '211 Patent.

Claims 24-30 stand rejected under 35 U.S.C. § 102(e) based on United States Patent No. 5,589,211 ("the '211 patent") to Cox *et al.* which was filed November 22, 1993. The present application is a continuation application having a priority date of January 7, 1994. Applicants note that the '211 patent was removed as a reference in the parent applications to the present application based on evidence of prior invention by Applicants. Applicants hereby incorporate the prior declarations of Dr. Vandepopuliere and Dr. Ball under 37 C.F.R. 1.131 which were submitted in the parent applications from which the current application claims priority and the arguments related thereto in their entirety. For the Examiner's convenience, copies of these declarations (without attachments) are provided at **Tabs C and D**. Applicants submit that these Declarations establish that Applicants were in possession of the present invention prior to the filing date of the '211 patent.

In view of the foregoing, Applicants submit that the rejection based on the '211 patent has been overcome and respectfully request withdrawal thereof.

IV. Double-Patenting Rejection.

Claims 24-30 stand rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-7 of U.S. Patent No. 6,303,176. Although Applicants do not agree with this rejection, a terminal disclaimer will be submitted to expedite the prosecution of this application if this rejection is still outstanding once the Examiner has identified otherwise allowable subject matter.

V. Conclusions.

The points and concerns raised by the Examiner in the outstanding Office Action having been addressed in full, it is respectfully submitted that this application is in condition for allowance, which action is respectfully requested. Should the Examiner have any remaining concerns, it is respectfully requested that he contact the undersigned attorney to expedite the prosecution of this application.

Respectfully submitted,

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Attachments: Tabs A-D

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PATENT TRADEMARK OFFICE

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, Washington, DC 20231, on February 25, 2002.

Sloan Hobbs
Date of Signature: February 25, 2002

Version with Markings to Show Changes Made

In the Specification:

Paragraph beginning at page 1, line 2 has been amended as follows:

The present invention relates to methods for pasteurizing shell eggs. More particularly the present invention relates to methods for reducing or eliminating *Salmonella* [salmonella] from shell eggs and for improving the storage capabilities of shell eggs.--

Section beginning at page 1, line 8 has been amended as follows:

It is well known that *Salmonella* [salmonella] organisms have been associated with egg products. More recently, *Salmonella enteritidis* (SE) has been detected within shell eggs. Presently, the presence of *Salmonella* [salmonella] within the shell egg is a major concern. Some states have enacted legislation preventing the serving of unpasteurized egg products unless fully cooked. In fact, since as early as 1969, the USDA has overseen the processing of liquid egg removed from the shell to reduce the level of *Salmonella* [salmonella] contamination to acceptable levels. However, no commercially acceptable methods have been developed to combat *Salmonella* [salmonella] in shell eggs. Since shell eggs must be used in situations where a liquid egg product cannot, it is therefore desirable to develop a commercially acceptable process for the reduction of *Salmonella* [salmonella] within shell eggs to provide a safe and functionally acceptable shell egg to the consumer.

Thermal treatments of shell egg to prevent embryonic growth in fertile eggs, to reduce incidence of spoilage during long term storage, and maintain internal quality received considerable research attention from about 1943 to about 1953. This research resulted from the nature of the egg industry at that time in that most of the eggs were produced by small flocks and the majority of the eggs used by the food industry were collected as seasonal surpluses in the spring. As a result of the production practices the eggs were more likely to

lose interior quality or become unfit for human consumption because of bacterial growth or embryonic development. Research into "thermostabilization" was directed at solving these problems, which were largely perceived as embryonic growth and the contamination of the egg from contaminants external to the shell. (See Egg Science, Stadelman and Coterill, (eds.), Chapter 4, 3d Ed., 1986).

U.S. Pat. No. 2,423,233 to Funk describes the thermostabilization of shell eggs. The '233 patent described a process of heating the shell egg to arrest embryonic development in the egg. As described in the '233 patent, when heating with water the preferred times and temperatures for the heat treatment were 138 degrees Fahrenheit for from five to ten minutes. However, the work of Dr. Funk was not concerned with the elimination of pathogenic organisms. In fact, the times and temperatures suggested by Dr. Funk for heating with water would not be sufficient to cause high enough levels of *Salmonella enteritidis* [SE] destruction to insure that a safe shell egg would result. Furthermore, because eggs available through modern production and distribution are fresher and have a lower pH they require a different thermal process than was used by Funk.

Accordingly, it is one object of the present invention to provide a safe shell egg product which is essentially free of *Salmonella* [salmonella] and more preferably free of *Salmonella enteritidis.*

It is another object of the present invention to provide a commercially acceptable process for reducing the levels of *Salmonella enteritidis* [SE] in shell eggs to acceptable levels.

It is still a further object of the present invention to provide a method of producing a *Salmonella* [salmonella] negative shell egg without requiring additional thermal treatments which could reduce the functionality of the shell egg.

Paragraphs beginning at page 3, line 15 has been amended as follows:

The present invention provides methods for producing a pasteurized shell egg while retaining the normal appearance of the shell egg contents.

The present invention, therefore, relates to a commercially viable method of producing a pasteurized shell egg. One particular embodiment of the present invention involves heating the shell egg in an aqueous solution of a predetermined temperature for a predetermined time. The heating at a predetermined time for a predetermined temperature provide to the albumen of the shell egg a total thermal treatment which can be described by an equivalent time and an equivalent temperature which define a point above the "Whites" ["whites 9D salmonella line"] line of Figure 1 but is insufficient to cause coagulation of either the albumen or the yolk of the shell egg.

In another aspect of the present invention the equivalent time and equivalent temperature define a point above the "Yolk" [yolk 9D salmonella] line of Figure 1, but again insufficient to cause coagulation of either the albumen or the yolk of the shell egg.

Paragraphs beginning at page 4, line 15 have been amended as follows:

Yet another aspect of the present invention provides a method of producing a pasteurized shell egg by heating the shell egg in an aqueous solution of a predetermined temperature and maintaining the shell egg in the aqueous solution for a predetermined time, wherein the predetermined time and the predetermined temperature define a point above the "Apparent F_0" [apparent F_0] line of Figure 1, and wherein the predetermined time and the predetermined temperature are insufficient to cause coagulation of the albumen or the yolk of the shell egg. A further aspect of the present invention provides a thermal treatment wherein the predetermined time and the predetermined temperature define a point below the "Expected Salmonella" [expected salmonella destruction] line of Figure 1.

The present invention is also directed to a pasteurized shell egg, wherein the albumen of said shell egg has received a thermal treatment sufficient to cause a 9D reduction in *Salmonella enteritidis* but insufficient to cause significant coagulation. In another aspect of the thermally treated shell egg, the yolk of the shell egg receives a thermal treatment sufficient to cause

a 9D reduction in Salmonella [*salmonella*] *enteritidis* but insufficient to cause coagulation.

Paragraph beginning at page 5, line 8 has been amended as follows:

Figure 1 is a graph of the apparent F_0 line superimposed on the thermal death time curves for Salmonella [salmonella].

Paragraphs beginning at page 5, line 28 have been amended as follows:

One aspect of the present invention involves the heating of shell eggs in an aqueous solution of a specified temperature for a time sufficient to cause at least a reduction in Salmonella enteritidis [*S. Enteriditis*] (SE) of greater than 5 log cycles (5D). More preferably, the shell egg is placed in aqueous solution wherein the time in the solution and the temperature of the solution impart a treatment to the shell egg sufficient to cause a greater than 7D reduction in SE, and most preferably a reduction in SE of greater than 9D. It is preferred that the treatment of the shell egg be sufficient to cause the reduction in SE in the albumen of the shell egg and most preferable that the treatment be sufficient to cause the SE reduction in both the albumen and the yolk of the shell egg. These reductions in SE should be accomplished while retaining the functionality of the shell egg (e.g., maintaining the egg yolk and egg white in essentially liquid form).

For comparative purposes, it is noted that PCT Application No. WO 93/03622 to Cox describes a method of "hyperpasteurization" of shell eggs. As is described in Figure 10 of Cox, relatively severe thermal treatments are expected to be required before Salmonella [salmonella] is destroyed. The data points shown in Figure 10 of Cox may be used to construct a line which reflects what would be an expected Salmonella [salmonella] destruction line for shell eggs. This "Expected Salmonella [expected *salmonella* destruction]" line is labelled as such and is shown in Figure 1 herein ("Expected Salmonella") and has the equation log(t)=8.456-0.1183T, where t is time in minutes [seconds] and T is temperature in °C. However, these more severe

thermal treatments could cause loss in functionality to the shell egg (e.g., partial or complete coagulation of the egg yolk or egg white).

Paragraph beginning at page 7, line 1 has been amended as follows:

In the present invention, the thermal treatment employed preferably defines a point below the "Expected Salmonella" [expected *Salmonella* destruction] line of Figure 1. Furthermore, the treatment of the shell egg should be insufficient to cause coagulation of either the albumen or the yolk of the shell egg. The methods of the present invention result in a SE negative shell egg having essentially the natural proportion of indigenous gases.

Paragraphs beginning at page 8, line 19 have been amended as follows:

While lower temperatures may be used, in practice, aqueous solution temperatures of greater than about 134°F (or about 56°C) and less than about 140°F (or about 60°C) are preferred and, as discussed above, it is preferred that the temperature of the solution remain approximately constant for the time the shell eggs are heated. Times of from about 20 minutes to about 45 minutes or greater may be selected to achieve the desired reduction in *Salmonella* [salmonella] with shorter times being required for higher temperatures. The specific times and temperatures required may vary with size, age and pH of the shell egg and whether the shell egg has been oiled before or after thermal treatment.

If an equivalent point analysis of the thermal treatment received by a particular portion of the shell egg is utilized to determine the reduction of SE in the shell egg, then the resulting equivalent time and equivalent temperature should define a point above the desired *Salmonella* [salmonella] thermal death time curves such as those shown in Figure 2 and Table 6 [Figure 6] of the USDA Egg Pasteurization Manual, ARS 74-38, Agricultural Research Service, United States Department of Agriculture, Albany, CA (1969), which are labelled as such and reproduced in Figure 1 herein and labelled as "Whites," "Yolk" and "Whole Egg".

If an F_0 analysis is employed in carrying out the present invention, then to assure a sufficient reduction in *Salmonella* [salmonella] such that no shell eggs test positive for *Salmonella* [salmonella] utilizing approved tests for *Salmonella* [salmonella], such as those approved by the USDA for use in liquid egg processing and discussed in the Egg Pasteurization Manual, then actual time and temperature combinations which define points at or above both the "Apparent F_0" [Apparent F_0] line and the *Salmonella* [salmonella] thermal death time curve of Figure 1 should be utilized. As will be understood by one of skill in the art, variations in shell egg physical characteristics, such as size, age, pH, etc., may cause the shell egg "Apparent F_0" [apparent F_0] line of Figure 1 to shift.

Paragraph beginning at page 12, line 18 has been amended as follows:

Table 1 presents the results of the thermal treatments on the survival of *S. enteritidis* inoculated into shell eggs. As temperature increased, the time required to obtain *Salmonella* [salmonella] negative eggs decreased. At 56°C, exposure time required to obtain no positive eggs was greater than 41 minutes. At 56.75 and 57.5°C, exposure times greater than 28 and 23 minutes, respectively, were required to obtain eggs negative for *Salmonella* [salmonella]. Standard USDA tests for *Salmonella* [salmonella] were utilized.

Paragraphs beginning at page 13, line 25 have been amended as follows:

Times at temperatures where none of the twelve inoculated eggs were positive, were used in a regression equation to determine the thermal death time curve (TDTC) presented in Figure 1 as the "Apparent F_0" line. The equation for the line is:

$$\log (t) = -0.1216 \times T + 8.4274$$

where t is the time in minutes and T is temperature in degrees Centigrade.

The R^2=0.86.

The above equation may be considered [consider] a workable approximation or an "Apparent F_0" [apparent F_0] line for *S. enteritidis* in shell eggs. The temperature range and times used to obtain the data were selected with the intent of determining if commercially reasonable thermal treatments would have sufficient lethality for *Salmonella sp.* It is expected that increasing the number of samples and extending the temperature range would result in some changes in the slope of the line, especially at lower temperatures (Cotterill et al., 1973). Based on concerns for the interior quality and their use in cooking, the practical upper temperature range would probably be less than 60°C. At temperatures in the range of 55 to 65°C, Cotterill et al. (1973) generally found linear TDTC for destruction of *S. oranienburg.* It is anticipated that the F_0 line for other forms of *Salmonella* [salmonella] in shell egg are also linear over that temperature range.

It is established that different strains of *Salmonella* [salmonella], the type of egg product [produce], and other environmental conditions will effect the thermal inactivation of *Salmonella* [salmonella]. Shah et al. (1991) presented D values for 17 strains of *S. enteritidis* in whole egg ranging from 13.7 to 31.3 seconds at 60°C. The average D was 19.2±5.4 sec. and was reported to be similar to previous data. Cotterill et al. (1973) and USDA (1969) provide data showing the influence of egg product type, pH, salt, and sugar on the thermal resistance of *Salmonella sp.* When evaluating the thermal resistance of *Salmonella* [salmonella] in intact shell eggs, the location of the bacteria within the egg becomes important. The thermal resistance of *Salmonella* [salmonella] in different egg products is as follows: plain yolk>whole egg or pH 7 egg white>pH 9 egg white (USDA, 1969). Therefore, increased thermal treatments would be required for plain yolk over whole egg or pH 7 egg white or pH 9 egg white.

In this study, the culture was placed in the egg white near the surface of the yolk. The consensus of those actively studying *S. enteritidis* infection of shell eggs is that the bacteria is found in the egg white of naturally infected eggs produced by infected hens (Gast and Beard, *J. Food Prot.*, **55**:152-156

(1991); Beard, *Egg Industry*, **92**:3337 (1992) [Gast and Beard, 1992; Beard, 1993]). The "Apparent F_0" [Apparent F_0] line was plotted in Figure 1, a redrawing of Figure 6 from the Egg Pasteurization Manual (USDA, 1969). This allows a visual evaluation of the thermal processes applied to intact shell eggs relative to accepted minimal pasteurization processes for liquid egg products.

When comparing the "Apparent F_0" [Apparent F_0] line and actual processes to the lines for pH 9 egg white and whole egg or pH 7 egg white, the shell egg processes seem to be more than adequate to achieve reductions of *S. enteritidis* sufficient for an accepted pasteurization process for protection of public health. The pH of the egg whites in this study ranged from 8.4 to 8.6 which is typical for shell eggs the age of those used in this study.

Although natural infections of the yolk are not expected at the time of ovulation, it is clear that under adverse handling conditions, *S. enteritidis* can be introduced into the egg and grow to very high numbers in the yolk (Hammack *et al.*, *Poultry Science*, **72**:373-377 (1993) [Hammack et al., 1993]). At 56°C [56.°C] (134°F), if the cells were in the yolk, the minimum holding time would be 36.42 minutes for an adequate pasteurization process. Since the "Apparent F_0" [apparent F_0] line crosses the USDA yolk pasteurization line at about 134°F, it is therefore preferred that thermal treatments for shell eggs at temperatures above 134°F be selected.

In addition to the F_0 analysis described above, an equivalent point analysis of the time-temperature curve of the thermal treatment imparted to the shell egg may be utilized to determine the total thermal treatment imparted various locations in the shell egg. A temperature probe was inserted into shell eggs in the aqueous solution at various depths into the egg. Temperatures were taken in the albumen at the yolk/albumen interface and in the yolk. These temperatures were taken using a hypodermic needle probe model HYP4-16-1-1/2-100-EU-48-RP manufactured by BIOMEGA® [Biomega] of Stamford Connecticut. The probe was inserted into the egg through a cork which was glued to the egg and prevented water from entering the egg through the aperture created by the probe. A DAYTRONIC® [Daytronic]

System 10 data acquisition unit was connected through an RS-232 serial connection to a personal computer. Temperature measurements were taken every 5 seconds and recorded. A representative thermal curve for a thermal treatment to the shell eggs is shown in Figure 2. To evaluate the equivalent point for the thermal curve shown in Figure 2, the thermal reduction relationship (G_{Ea}) is calculated using the following equation:

$$G_{Ea} = \int_0^{t_{final}} e^{-\frac{Ea}{RT(t)}} dt$$

where Ea is the activation energy (J/mol), R is the Universal Gas Constant (8.314 J/mol,K), T(t) is temperature as a function of time (°K) and t_{final} is the final processing time (s). This integration process is then repeated for a number of activation energies (Ea). Each G_{Ea} value defines a line of equivalent thermal treatments for that particular activation energy (Ea). The intersection of the lines defined by the G_{Ea}'s is the equivalent point of the thermal process. (Swartzel, 1986, *J. Agric. Food Chem.*, **34**:397).

Paragraph beginning at page 17, line 4 has been amended as follows:

Use of the time and temperature relationships discussed above should result in a shell egg which may be guaranteed to be *Salmonella* [salmonella] negative. As used herein *Salmonella* [salmonella] negative means a negative result indicating the absence of harmful *Salmonella* [salmonella] as determined by USDA approved methods of *Salmonella* [salmonella] testing. This insured *Salmonella* [salmonella] negative shell egg is referred to herein as a pasteurized shell egg.

Paragraph beginning at page 17, line 14 has been amended as follows:

Quality and functional attributes of shell eggs heated at 56.75 and 57.5°C with and without oiling are summarized in Table 2. The expected ability of oiling egg shells to maintain fresh egg pH and interior quality is evident. The egg white pH of the oiled eggs is clearly lower than for the

unoiled eggs regardless of storage temperature. The thermal treatments did not seem to have an effect on egg white pH, but did seem to have an impact on interior quality as indicated by the Haugh unit values. For the non-thermally treated eggs, oiling held egg white pH and resulted in higher Haugh values at both storage temperatures. Oiling the thermally treated eggs appeared to help maintain interior quality if they were stored at room temperature (22.2°C). The thermal treatments alone, provided good protection of interior quality. All thermally treated eggs regardless of oiling or storage temperature would be considered high A or AA quality grades. There seemed to be less correlation of egg white pH with interior quality than might have been expected. This is particularly so when comparing the egg white pH and Haugh units of oiled and unoiled eggs. That result suggests the thermal treatments are stabilizing interior quality independently of deterioration mechanisms related to change in egg white pH. Funk U.S. Pat. No. 2,423,233 (1947) claimed that heating shell eggs for 5 to 40 minutes at temperatures of 60 to 43.4°C, respectively, would maintain interior quality without impairing the whipping qualities. However, he did not define quality or whipping qualities.

Table beginning at line 9, page 18 has been amended as follows:

Table 3: Quality and Functional attributes of thermally treated shell eggs with and without oiling four weeks storage at 22.2 or 7.2°C.

	Egg White pH		Haugh Unit		Whip Volume[a]		Whip Time[b]	
No Oil	22.2C	7.2C	22.2C	7.2C	22.2C	7.2C	22.2C	7.2C
No Heat	9.3	9.2	20	60	1,000	900	40	45
56.75C, 36 min.	9.2	8.9	78	82	550	650	220	110
57.5C, 23 min.	9.2	9.1	74	82	750	600	280	130
Oiled								
No Heat	8.0	8.1	58	70	950	800	45	45
56.75C, 36 min.	7.9	8.2	80	80	550	650	190	200
57.5C, 23 min.	8.0	8.1	81	82	600	700	200	210

[a]Whip Volume in ml.
[b]Whip Time in sec. [min.]

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